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The Bulliform or Hygroscopic Cells of Grasses and Sedges compared.*

W. J. BEAL.

(WITH PLATE X.)

As so little attention has been given to this topic, it will be necessary first to describe briefly the leaf of a grass. In general, it consists of a *sheath* encircling the stem, and a *lamina* spreading from the upper part of the sheath. The blade is traversed longitudinally by fibro-vascular bundles which vary much in size and degree of perfection. In viewing a magnified transverse section of a mature leaf of Sesleria (fig. 1), we see: *e*, an outer envelope of cells, the epidermis; *b*, the median fibro-vascular bundle; *h*, *h*, lateral bundles; *a*, the lower median strand of hypodermal fibers; *d*, the upper median strand; *c*, *d'*, the lateral strands. The other cells are parenchymatous, most of them containing granules of chlorophyll. The vacancy, *i*, is the lacuna, caused by the rupture of some cells. In aquatic grasses the lacunæ are very large. The epidermal system consists of: *a*, epidermis proper; *f*, *g*, bulliform (blister) cells; *c*, stomata; *d*, trichomes.

Of the bulliform cells I speak more particularly. They are in longitudinal parallel lines, are larger, extend further into the leaf, and have thinner walls than ordinary epidermal cells. They are usually more or less wedge-shaped, with the point of the wedge towards the outside of the leaf. When dry, these cells contract and aid in closing the leaf in two or three ways; when moist the leaf expands again. In Zea Mays (fig. 2) these cells are raised above the others and puff out like a blister. When viewed on the surface of the leaf the bulliform cells are usually seen to have the proportions of length and width much like those next to them.

The number of rows in a species appears to be always uniform, but the number varies with the species from three to twelve in a band. If there are many rows the cells are shallow: if few, the cells are deep; if three only, those at the side are small, and the middle one is very large. The arrangement or plan of these cells is quite constant in a species, but in a genus they often vary widely.

The following examples will give some notion of the variety, the sections being made in the widest part of the leaf:

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*Read before the A. A. A. S. Buffalo meeting, 1886.

1. The leaves of Dactylis glomerata have one median band (fig. 3).

2. In Chloris petræa there is one middle band, and one or more on each side.

3. The leaves of Poa pratensis have two bands, one on each side of the middle (fig. 4).

4. Andropogon squarrosus has one band each side of the middle and a small one at each edge.

5. The leaf of Phleum pratense has one band of several shallow cells each side of the middle and others between the veins (fig. 5).

6. The leaves of Zea Mays have a band between each two primary bundles and above each third class bundle (fig. 2.)

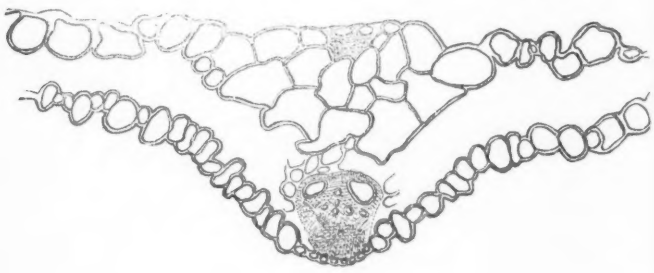


FIG. 10.

7. The leaf of Leersia oryzoides has numerous bands on the upper surface each side of the middle, and one band each side of the keel on the lower side (fig. 6).

8. The leaf of Amphicarpum Purshii has opposite bands of bulliform cells on both surfaces, though those above are most prominent (fig. 7).

9. In case of the leaves of Panicum plicatum the bands of bulliform cells are first on the upper side and then on the lower, and are found in grooves (fig. 8).

10. The leaf of Andropogon prinoides has large epidermal cells of nearly uniform size distributed all along the surface, excepting over the veins (fig. 9).

11. The leaf of Paspalum plicatum has a very irregular epidermis, with groups of cells in the center of the leaf, several above each other, as well as side by side, all acting as bulliform cells (fig. 10, text).

In vernation the leaves take the same positions as when full grown and dried, though the bulliform cells at that time are very

small. The leaves of Dactylis and Poa pratensis are conduplicate when slowly dried, while those of Phleum are convolute. The leaves of Panicum plicatum, when dry, close in a zigzag manner like a fan. The object accomplished by the closing or rolling of the leaves is to cover one surface and assist in preventing excessive evaporation in dry weather.

The examples here cited belong to various genera and tribes of grasses, and give a fair idea of the varied forms of bulliform cells, though these are by no means all the varieties that might be shown.

In a similar manner let us now glance at some of our common species of Cyperaceæ, and compare them with some leaves of grasses.

1. The leaf of Cyperus rotundus, var. Hydra, is narrow and thin, having a single deep band of bulliform cells above the midvein (fig. 11). The epidermal cells are rather large and nearly uniform in size. The bulliform cells are much like those of Dactylis glomerata. The epidermal cells on the upper side are much larger.

2. In case of Kyllingia pumila the upper epidermis occupies nearly half the thickness of the leaf, the cells above the midvein being scarcely larger than those on either side (fig. 12). This leaf may be compared with Andropogon prinoides, though in the latter case the epidermal cells over the veins are small.

3. The leaves of Heleocharis, so far as seen, have leaf-blades which are very small or rudimentary.

4. The leaves of Scirpus sylvestris are wide, with many veins, opposite each one of which, above and below, there is a depression. There is one band of about eight cells above the midvein and these have only a moderate depth. The epidermal cells are rather small and can scarcely act as bulliform cells. The leaf much resembles that of Dactylis glomerata, but the bulliform cells are not so deep.

5. The blades of Scirpus validus, the great bulrush, are very short, almost rudimentary. The lacunæ are large and near the upper surface of the leaf. The cells of the upper epidermis, as well as several layers below, are rather small, thin-walled, not varying much in size. All of these small cells act as bulliform cells and the leaf becomes convolute or involute when drying.

6. The leaves of Fimbristylis autumnalis (fig. 13) have a thick epidermis of one layer of thin-walled cells, which extend nearly to the lower side of the leaf. This much resembles the leaf of Andropogon prinoides, though in the latter the cells over the veins are small.

7. On examining a leaf of Eriophorum Virginicum we see that it is very thick, with many veins and lacunæ. The epidermis is composed of small cells; the single band of bulliform cells over the midvein consists of about eight rows of considerable depth. The epidermal and bulliform cells are much like those of Dactylis glomerata.

8. In Fuirena squarrosa the cells of the upper epidermis extend about one-third the depth of the leaf and are somewhat uniform in size. There is no special enlargement of these cells above the midvein. The epidermis is much like that of Fimbristylis autumnalis and Kyllingia pumila among sedges, and Andropogon prinoides among grasses, except the cells above the leading veins are as large as any, while in the grass they are very small over the veins.

So far the examples of leaves of sedges noticed belong to one tribe, Scirpeæ.

9. The leaves of Rhynchospora capillacea (fig. 14) are very narrow, with a few veins, small epidermal cells, and a band of bulliform cells reaching more than half way across and extending nearly one-third the depth of the leaf. This may be compared to a very narrow leaf or the apex of a leaf of Dactylis.

10. The leaf of Cladium mariscoides is rather thick, becoming thinner at the margins and toward the midvein. The epidermal cells are small and have thin walls; there are many layers of similar thin-walled parenchyma cells below the epidermis; but no distinct band of bulliform cells. The leaf reminds us very much of the leaf-blade of Scirpus validus.

The last two examples belong to the Rhynchosporeæ.

11. The bulliform cells of Scleria triglomerata are much like those of Carex vulpinoidea (fig. 15).

The following eight examples are selected from the large and difficult genus Carex:

12. The blade of C. vulpinoidea (fig. 15) is of medium thickness, having about six bulliform cells extending one-third the way to the lower side of the broad shallow midvein. Between the veins there is a noticeable enlargement of about six epidermal cells, the other epidermal cells being rather large. These side bands approach in appearance the side bands in Phleum pratense, only they are less distinct.

13. C. lagopodioides has a leaf much resembling the last, but the epidermal cells do not show a resemblance to bulliform cells.

14. C. Grayii is a coarse species found in low and wet places. The epidermal cells are of moderate size; the lacunæ are large.

There is one band of bulliform cells of about twelve rows, extending one-half the depth of the leaf, if the deep narrow midvein is not taken into account. So far as bulliform cells are concerned this reminds us of a leaf of Dactylis glomerata.

15. C. Pennsylvanica is an early upland sedge with narrow leaves. The epidermis (fig. 16) is composed of small cells. There are six rows in each bulliform band, and these extend about two-fifths of the way down to the lower side of the midvein. The epidermal and bulliform cells remind us again of a leaf of Dactylis glomerata.

16. The blade of C. utriculata is very thick, narrowing to the margin and in the center. The epidermal cells are of moderate size; the single band of bulliform cells number about ten and are over the midvein. This leaf reminds us very much of that of Eriophorum Virginicum, but in the former the vessels of the fibro-vascular bundles are near the upper surface, while in the latter they are near the lower side.

17. In the wide coarse leaf of C. Careyana (fig. 17) the upper epidermal cells are rather prominent, varying considerably in size. There is one very wide band of about twenty bulliform cells over the midvein. In the center of the leaf they extend two-fifths of the distance to the base of the vein. About half way from the midvein to the margin of each side of the blade there is a longitudinal crest or ridge on the upper side. The prominent vein at this place has small epidermal cells and hypodermal fibers. On the upper surface on either side of this vein and ridge the epidermal cells resemble a wide shallow band of bulliform cells.

18. The leaf of C. Hitchcockiana is much like the last one named, and there are many leaves of Carex proper of like structure.

19. The leaf of C. laxiflora, var. latifolia (fig. 18) is about an inch wide and rather thin. The epidermal cells are somewhat prominent. There is one band in the middle of about ten bulliform cells, which cause this wide leaf to be conduplicate when dry.

In the leaves of Carex the pitted vessels of the fibro-vascular bundles are near the lower side of the leaf.

It will be seen that all the leaves of sedges have been compared with some one of five genera of grasses. In the sedges, so far as studied (many genera of four tribes), I find nothing in the middle of the leaf to compare with that of Poa pratensis, Phleum pratense, Leersia oryzoides, Amphicarpum Purshii, or Panicum plicatum. The bulliform cells and other epidermal cells, the hypodermal fibres, and the lacunæ vary more in grasses than in sedges, or in other words, we find a greater variety of forms of

these cells or groups of cells in grasses than in sedges. Perhaps we should expect this as most of the sedges thrive in wet places, where the conditions are uniform, while the grasses thrive in a much greater variety of places. Still we find a greater differentiation of parts in the leaves of marsh grasses than in the sedges growing near them.

Some of these characters in the leaves of grasses and sedges may be useful in description and classification.

EXPLANATION OF PLATE X.—The drawings are all diagrammatic and represent portions of the tranverse sections of the leaf. Fig. 1, Sesleria cærulea; *a*, median strand of hypodermal fibres; *b*, median fibro-vascular bundle; *c d'*, lateral strands of hypodermal fibres; *e*, epidermis; *f*, bulliform cells when leaf is closed; *g*, same when leaf is open; *h h*, lateral fibro-vascular bundles; *i*, lacuna, ×120 (Douval-Jouvé). Fig. 2, Zea Mays, ×17 (Sudworth, in Beal's Grasses). Fig. 3, Dactylis glomerata, ×38 (Sudworth, l. c). Fig. 4, Poa pratensis, ×75 (Sudworth, l. c). Fig. 5, Phleum pratense, ×20 (Sudworth, l. c). Fig. 6, Leersia oryzoides, ×350 (Douval Jouvé). Fig. 7, Amphicarpum Purshii, ×25 (Sudworth, l. c). Fig. 8, Panicum plicatum, ×10 (Douval-Jouvé). Fig. 9, Andropogon prinoides, ×50 (Douval-Jouvé). Fig. 11, Cyperus rotundus, var. Hydra, ×55. Fig. 12, Kyllingia pumila, ×55. Fig. 13, Fimbristylis autumnalis, ×55. Fig. 14, Rhynchospora capillacea, ×55. Fig. 15, Carex vulpinoidea, ×46. Fig. 16, C. Pennsylvanica, ×55. Fig. 17, C. Careyana, ×55. Fig. 18, C. laxiflora, var. latifolia, ×55.

Hierochloa borealis.

WALTER DEANE.

A visit at Rye Beach, N. H., during the month of August, 1886, and an acquaintance with an Indian named Sabbatis Dana, who camps in the town every summer and sells baskets and other articles, have given me some interesting facts in regard to the Hierochloa borealis, or Holy Grass. It is one of our widely distributed grasses, ranging over the northern half of the United States and northward. In this section of the country, eastern New England, it is generally found near the sea shore, and is one of our earliest flowering grasses. I have collected it in the middle of May and, at that time, only the culm, rising from the creeping root-stocks, is visible. Later in the season, from the same root-stocks, at intervals of two or three inches, there grow radical leaves in tufts. In the months of July and August these leaves reach their full height. The length of the grass much surprised me, as I can find no mention made of it. I saw it three feet in

height, and I was assured that it grew much higher. In a salt marsh near by there was a patch of half an acre covered with this grass, its delicate green leaves, a quarter of an inch in width, contrasting sharply with the dark and wiry Spartina juncea, which covered the rest of the marsh. I can find no mention of these radical leaves, growing later from different parts of the original root-stocks, and I do not think that the fact can be generally known. At least it may be interesting to call it to mind. The dead culm and flowers remain standing erect during the season, hardly seeming to belong to the fresh over-topping leaves.

This grass, as is well known, becomes very fragrant when dried, whence its name, Vanilla Grass. Bigelow says, "This is one of our earliest grasses and is distinguished by the delightfully fragrant odor while drying." In Germany, on festival days, it is strewn before the doors of churches on account of its fragrance and is called, as the generic name implies, Holy Grass. These radical leaves are used very largely by the Penobscot Indians in the manufacture of their baskets, etc. Sabbatis Dana is one of the remnant of the Penobscot tribe, from 400 to 500 in number, who live at Old Town Island, Me., on the Penobscot river. In the summer time large numbers of them visit the various fashionable resorts and ply their profitable trade. Sabbatis has been at Rye Beach for twenty-six consecutive summers. The Hierochloa borealis is known among the Indians as Sweet Grass. There is no Indian name for it, even those Indians who know no other English using this name. They pick it in large quantities and hang it up in small bunches from the ridgepole of their tents to dry, the fragrance being much stronger if dried away from the sun. In this way, I was told, that the scent would last for years. The leaves, in drying, become strongly involute, making a fine pliable thread, very different in appearance and color from the fresh state.

The Indians do not know the plant in flower. Indeed, I was positively assured that it never flowered at all, the reason for this statement being obvious. For when the grass is gathered the flowers have long gone by. I showed Sabbatis the dead culms but, looking wisely at them, he shook his head and said, "That is not Sweet Grass." He had seen those amongst the leaves, but they did not belong to the grass, and he refused to be convinced until I produced a specimen with the old culm and fresh radical leaves rising from the same root-stock. Then he was much surprised and interested. Of course, in pulling up the leaves as they do, but little, if any, of the root-stock remains attached. The Indians know the grass by experience, the base of each tuft, in the fresh

plant, being quite red in color after the outermost leaves are removed. They always carefully pick over the grass when brought home, stripping off the older, outer leaves which, they say, have no fragrance.

In using the grass it is generally braided into strips as fine or as coarse as they require, and of any desired length, and is then woven into baskets and other fancy work. As it takes a good deal of time to pick the grass, dry and braid it, the Indians often buy it of those who gather and prepare it for sale, paying for it so much a pound. The wood used, which forms the main part of these articles, is white ash, Fraxinus Americana, and red maple, Acer rubrum, called in Maine white maple. These woods they prepare at home, splitting the ash into strips of the requisite thinness and width by means of a machine. The maple is used for the heavier parts, such as the frame work and handles. The pieces are stained with some coloring material and are then ready for use. Baskets and articles of that sort are always made over a block to preserve the shape, and I was told that it would be impossible to make a basket, with Sweet Grass in it, without a block, as the grass would draw the basket out of shape. I saw some very delicate specimens of weaving. They frequently use horse hair in making very small baskets for charms, being less than half an inch in width; the frame work is of ash and the weaving is almost microscopic. I noticed among the articles for sale in the Indian tent, some small boats, beautifully cut out of white cedar or arbor vitae, Thuja occidentalis, while the bark of the paper birch, Betula papyracea, was made into baskets, music rolls, etc.

Notes on Carex. VIII.—Hybrids.

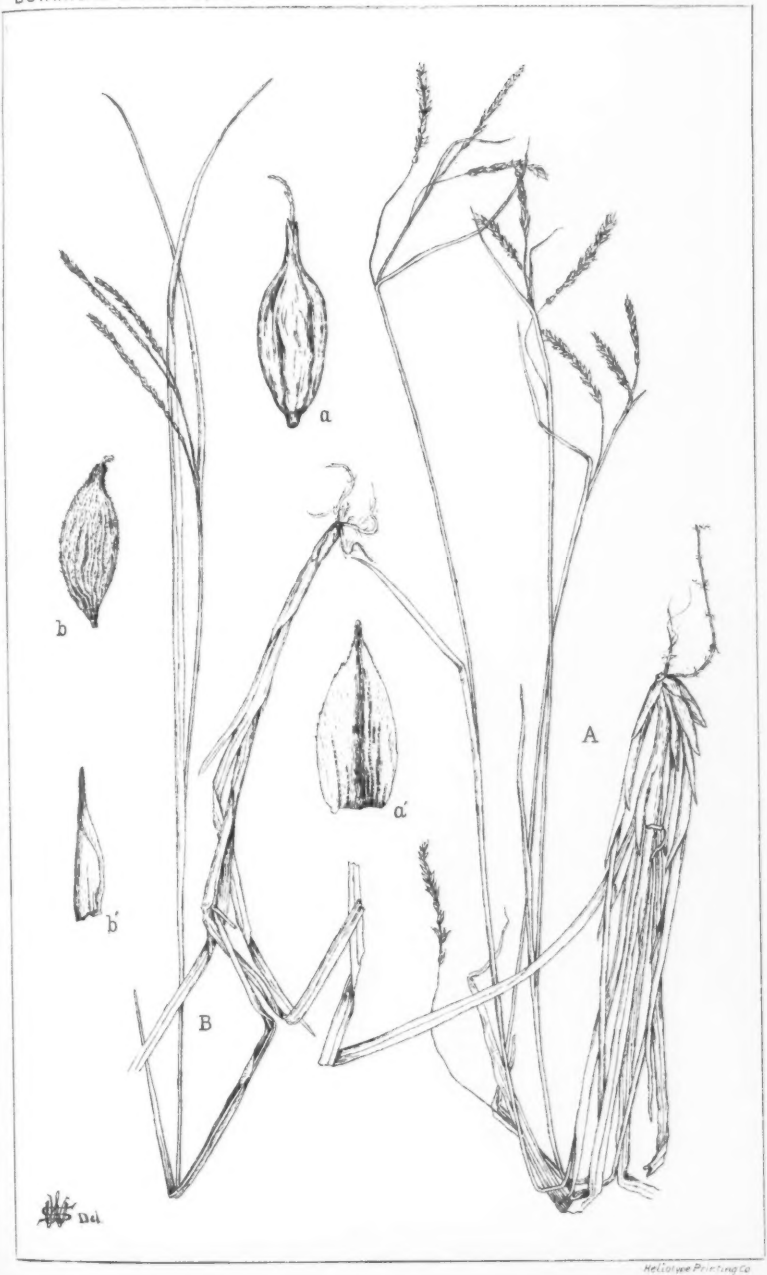
L. H. BAILEY, JR.

(WITH PLATE XI.)

CAREX ARCTATA × FLEXILIS.

C. Knieskernii Dewey, Sill. Journ. 2d ser. ii. 247. *C. arctata* × *formosa?* Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 104.

In a recent trip to the northern boundary of Minnesota, I found a quantity of this rare Carex and growing in such intimate association with Carex arctata and Carex flexilis that all doubt was at once removed as to its parentage. I had long been confident that the plant is a hybrid, and that Carex arctata is one of



BAILEY ON CAREX.

its parents, but it had not occurred to me that the rare Carex flexilis is the other parent. In the Synopsis of North American Carices I guessed at Carex formosa as being the other parent, although that plant had not been found in the vicinity of Lake Superior, where Professor Macoun had found the hybrid. Dr. Vasey has loaned me the original specimens of Carex Knieskernii, together with Carex flexilis from the same source, and adds this note: "The original Carex Knieskernii was collected by myself, in company with Dr. Knieskern, on the ground of old Fort Bull, somewhere west or northwest of Rome, N. Y., near a small stream which, if I remember correctly, was called Fish Creek, and empties into Oneida Lake. The specimens of Carex flexilis are from the same locality." This first collection was made in 1841. In 1869 Professor Macoun collected it at Kakabeka Falls, on the Canadian side of Lake Superior. The third finding was that of the present summer, a few miles this side of the international boundary. I obtained about a hundred specimens from two or three contiguous localities. Judging from its comparative frequency in these localities, I should expect to find the hybrid wherever Carex aretata and Carex flexilis grow near each other. Some of my specimens are almost indistinguishable from one parent, some from the other. They appear to have been the products of reciprocal crosses. The hybrid may be distinguished in general as follows:

Culm one and a half to two feet high, longer than the flat leaves, all usually somewhat hairy as in C. flexilis; spikes one to two inches long, drooping or spreading on very slender peduncles, mostly sparsely alternately flowered at the base, rusty, or whitish in color; perigynium empty, rusty, mostly lance-ovate and in at least the northern specimens very conspicuously beaked, lightly nerved, thin in texture, mostly surpassing the whitish, pointed scale (Fig. A).

It is singular that a genus possessing imperfect flowers and so many species should present so few hybrids. I enumerate all the remaining hybrid Carices which have been clearly made out in this country:

CAREX DEBILIS×VIRESCENS Bailey, Proc. Amer. Acad. Arts and Sci., xxii. 105.—Plant slender and lax, very green, appearing as if immature; culm flattish, rough on the angles; leaves flat, rough, mostly longer than the culm; bracts narrow, usually much exceeding the culm; spikes two or three, two inches long, thin and slender, erect or nearly so, the terminal one bearing a few pistillate flowers at the top; perigynium, which is nearly an exact medium between the two species, lance-ovate,

nerved and slightly hairy, short beaked, thin in texture, empty, twice longer than the white-hyaline scale.—Revere, near Boston, Mass. C. E. Faxon. (Fig. B.)

CAREX GRACILLIMA × PUBESCENS Bailey, l. c. 107.
C. Sullivantii Boott, Sill. Journ. xlii. 29.

CAREX STRICTA × SALINA Bailey, l. c. 85.
C. spiculosa? W. Boott, Bot. Gaz. ix. 88.
"*Forma sterilis salinæ*" Christ, Cat. Car. Eur. 7.

CAREX TENTACULATA × LURIDA Bailey, l. c. 69.
C. tentaculata, var.? *altior* Boott, Ill. 94.

CAREX BULLATA × UTRICULATA Bailey, l. c. 68.
C. Olneyi Boott, Ill. 15, t. 42.

EXPLANATION OF PLATE XI.—*A*, Carex arctata ×flexilis, ×½; *a*, perigynium; *a'*, scale of same, ×7.
B, Carex gracillima ×virescens, ×½; *b*, perigynium; *b'*, scale of same, ×7.

The Flora of our Southwestern Archipelago. II.[1]

WM. S. LYON.

The absence of the great genus Astragalus from Guadalupe struck Mr. Watson as somewhat remarkable.[2] It seems to the writer, however, phenomenal that the genus should have any representation not only upon that island, but upon any of those under our consideration.

The "Rattleweeds" take as kindly as does the horned toad to the dry, arid basins of the interior, and of the vast number known but few are reported from the immediate sea-board. Only four species I know of approach anywhere near the coast-line adjacent to the Santa Barbara group.[3] The papery texture of the pods of most species unfits them for transportation by water, while the pernicious nature of some species makes them avoided by animals, and an inherent antipathy to the moisture-laden atmosphere of the seas keeps them mainly retired from the coast. Nevertheless three species manage to reach Catalina, two get to Cedros, one to Clemente, and the genus does not fail altogether till far out at sea on Guadalupe.

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[1] Continued from page 205. begun p. 197.
[2] Proc. Am. Acad. l. c. p. iii.
[3] A. leucopsis, A. Antiselli, A. didymocarpus, A. pycnostachyus.

Of the three species reaching Catalina, two are common to the immediate coast, and their migration is less a matter of wonderment than the development of an entirely new and interesting species (A. Nevinii) upon Clemente, which can only be accounted for by assuming that the potency of insular influences in the elaboration of new types have succeeded in overcoming what I believe to be the natural antagonism of the genus to the tide line.[4]

Localization of species is the next feature which arrests our attention. Hemizonia Streetsii is not infrequent on the east end of Catalina, extending quite down to (and there in greater abundance than elsewhere) the narrow isthmus which connects the east and west sections of the island. A strong current of wind at nearly all times sucks through this narrow causeway, across which one might almost throw a stone; otherwise all conditions of soil and climate seem identical on both sides. Diligent search during two seasons failed to reward me with a sight of this species from the west end. The current of wind seems insufficient to account for this peculiarity, as all other species pass and repass freely. Paucity of species is worthy of mention, more striking in Catalina than in Clemente or Guadalupe, since the former island possesses in an eminent degree all the physical requirements of a large and varied flora: great size, low fertile valleys, swamp lands, river bottoms (in miniature), rolling hills, sub-alpine elevations, densely wooded and naked exposures, and is not even wanting on the south side our so-called "desert" country. Excepting only the region of perpetual snow in the upper Sierras, the whole of southern California, with upwards of 2,000 species, presents no greater variety of physical conditions than exist here, yet only a total of 153 species are reported from this island. Collections from Guadalupe and Clemente having been made only in the spring, will probably be augmented by future exploration, yet those so far reported are meager in the extreme.

A summary of Mr. Greene's list, and that subjoined, shows a total of only 287 Phanerogams and ferns from these three islands. Of these, 46, or 16 per cent. of the whole number, are strictly insular. Of the 287, 23, or 8 per cent., are limited to Guadalupe; 10, or about $3\frac{1}{2}$ per cent., restricted to Catalina; and 5, or about $1\frac{3}{4}$ per cent., peculiar to Clemente. The 23 Guadalupe species constitute 17 per cent. of the whole 133 species reported from that island. The 10 Catalina species form $6\frac{1}{2}$ per cent of the 153 species listed from thence; and the 5 from Clemente are about 6

[4] This peculiarity has been noted of the genus Astragalus more strongly than of any other of the great genera characteristic of California flora; among which may be cited Hosackia, Lupinus, Krynitzkia, Mimulus and Eriogonum, all of which are abundantly represented in closest proximity to the sea shore.

per cent. of the 81 species collected on that island. Lastly, 31, or 38 per cent. of the whole flora of Clemente is reported also from Guadalupe; and 35, or only 23 per cent., of that of Catalina is common to itself and Guadalupe. More significance attaches to this latter analysis than to the others, as it seems to indicate a closer relationship between the floras of Clemente and the distant Guadalupe than obtains on the two nearer islands.[5]

At this point it is proper to refer back to the statement made in relation to the antiquity of Clemente, that the geology and present flora of that island were not in apparent harmony. This hypothesis, determined by the scantiness of peculiar species, is far from conclusive. Greater antiquity would afford opportunity for the extension landward of many perhaps original species whose local identification would thus be absorbed and lost forever; and if the faintest value be attached to the common methods of seed dispersal, facilities have occurred for the distribution of a score of distinctive floras; and while strongly disparaging those very methods in general, their specific force and application is readily conceded where the barrier to isolation becomes contemptible, in view of the stupendous lapses of time since the seas first swept the uppermost terraces of Clemente.

From all the foregoing we briefly suggest:

1st. Present variation and constant modifications in matter of size point to the mutability of species upon these islands.

2d. The large percentage (16) of the whole flora being characteristic, tends strongly to indicate insular genesis.

3d. That there are no barriers which some species can not overcome; while the close restriction of others to local habitats and seeming to enjoy greater facilities for expansion than the first named, would indicate that the latter species were too short-lived to acquire the adaptability and availability for extension possessed by the former.

4th. That the material available for investigation is of too conflicting a nature to formulate even a scientific "guess" as to primative origin of the floras of these islands.

The discovery of a new genus on Catalina and Santa Cruz[6], whose definite characters and relationship is not yet wholly settled, but whose nearest apparent affiliation is native of northern Mexico, might lead us to inquire for some such derivation; but Mr. Watson has shown how unlikely is this to be the case with

[5] Since making the above analysis, the publication of some new species and extension of the limits of others by Dr. Gray in his recent revised supplement to the Syn. Flora of N. America affects the exactitude of the enumerations given, but not enough to vitiate the general conclusions.

[6] Proc. Am. Acad., vol. 20.

Guadalupe, hence with our northern group. From the presence of a few sporadic South American forms it would be as unsatisfactory to attempt in any way to connect their floras as to deduce anything European from the presence of Lavatera.

Have these islands ever formed part of a continuous territory? Have they ever been united to the adjacent continent? Is their antiquity greater or less than that of the main land?

These, and a host of correlated questions, must first be answered authoritatively by the geologist who undertakes their careful exploration; until then the botanist must relegate the history of the past to the field of idle speculation, and from the pregnant material at hand confine himself to defining the present—anticipating the future.

LIST OF FLOWERING PLANTS AND FERNS OF SANTA CATALINA ISLAND.

1. Clematis ligusticifolia Nutt.
2. Eschscholtzia peninsularis Greene
3. Crossosoma Californicum Nutt.
4. Dendromecon rigidum Benth.
5. Isomeris arborea Nutt.
6. Capsella Bursa-pastoris Mœnch.
7. Oligomeris subulata Boiss.
8. Helianthemum scoparium Nutt.
9. Frankenia grandifolia C. & S.
10. Silene Gallica Linn.
11. Stellaria media Linn.
12. Lepigonum macrothecum F.& M.
13. Sagina occidentalis Wats.
14. Malvastrum Thurberi Gray.
15. Erodium cicutarium L'Her.
16. Rhamnus crocea Nutt.
17. Ceanothus sorediatus H. & A.
18. Rhus diversiloba Hook. & Arn.
19. Rhus ovata Wats.
20. Rhus integrifolia Benth. & Hook.
20a. Rhus integrifolia (a remarkable ternate-leaved form).
21. Rhus laurina Nutt.
22. Trifolium microcephalum Pursh.
23. Melilotus parviflora Desf.
24. Medicago denticulata Willd.
25. Hosackia glabra Torr.
26. Hosackia micrantha Nutt.
27. Hosackia maritima Nutt.
28. Hosackia ornithopus Greene.
29. Astragalus leucopsis T. & G.
30. Astragalus trichopodus Gray.
31. Astragalus Antiselli Gray.
32. Lathyrus vestitus Nutt.
33. Prunus occidentalis Nutt.
34. Prunus ilicifolia Walp.
35. Spiræa discolor Pursh.
36. Rubus ursinus Cham. & Schlecht.
37. Cercocarpus parvifolius Nutt.
38. Adenostoma fasciculatum Hook. & Arn.
39. Alchemilla arvensis Scopoli.
40. Rosa Californica Cham. & Schlecht.
41. Heteromeles arbutifolia Rœm.
42. Lyonothamnus floribundus Gray.
43. Ribes viburnifolia Gray.
44. Tillæa minima Miers.
45. Cotyledon cæspitosa Haworth.
46. Zauschneria Californica Presl.
47. Œnothera micrantha Hornem.
48. Œnothera bistorta Nutt.
49. Godetia tenella Wats.
50. Megarrhiza Californica Torr.
51. Megarrhiza Marah, reported by Baker, not collected since.
52. Opuntia Engelmanni Salm.
53. Mesembryanthemum crystallinum Linn.
54. Caucalis microcarpa Hook & Arn
55. Sambucus glauca Nutt.
56. Symphoricarpos mollis Nutt.
57. Lonicera hispidula, var. vacillans Dougl.
58. Galium angustifolium Nutt.
59. Galium Aparine, var. Vaillanti Gray.
60. Galium Catalinense Gray, *ined.*
61. Brickellia Californica Gray.
62. Pentachæta Lyoni Gray.
63. Bigelovia veneta Gray.
64. Erigeron foliosus Nutt.
65. Baccharis pilularis DC.
66. Stylocline gnaphalioides Nutt.

67. Filago Arizonica Gray.
68. Encelia Californica Nutt.
69. Leptosyne gigantea Kellogg.
70. Madia sativa Molina.
71. Madia filipes Gray.
72. Hemizonia Streetsii Gray.
73. Hemizonia fasciculata T. & G.
74. Layia platyglossa, var. breviseta Gray.
75. Bæria Palmeri, var. Clementina Gray.
76. Amblyopappus pusillus Hook & Arn.
77. Achillea Millefolium Linn.
78. Cotula coronopifolia Linn.
79. Artemisia Californica Less.
80. Cnicus occidentalis Gray.
81. Centaurea Melitensis Linn.
82. Perezia microcephala Gray.
83. Stephanomeria paniculata Nutt.
84. Malacothrix saxatilis T. & G.
85. Arctostaphylos tomentosa, Dougl.
86. Arctostaphylos bicolor Gray.
87. Erythræa venusta Gray.
88. Gilia atractyloides Steudel.
89. Gilia multicaulis Benth.
90. Eucrypta (Ellisia) chrysanthemifolia Greene.
91. Phacelia hispida Gray.
92. Phacelia Lyoni Gray.
93. Emmenanthe penduliflora Benth.
94. Eriodictyon tomentosum Benth.
95. Heliotropium Curassavicum Linn.
96. Krynitzkia ambigua Gray.
97. Krynitzkia ramosissima Gray.
98. Plagiobothrys Arizonicus, var. Catalinense Gray, *ined.*
99. Convolvulus Soldanella Linn.
100. Convolvulus macrostegius Greene
101. Convolvulus Californicus Choisy.
102. Cressa Cretica Linn.
103. Solanum nigrum Linn.
104. Solanum Xanti, var. Wallacei Gray.
105. Lycium Californicum Nutt.
106. Scrophularia Californica Cham.
107. Pentstemon cordifolius Benth.
108. Antirrhinum Nuttaliianum Benth.
109. Antirrhinum speciosum Gray—coll. by Gambel.
110. Mimulus glutinosus, var. puniceus Wendl.
111. Mimulus cardinalis Dougl.
112. Mimulus luteus Linn.
113. Mimulus floribundus Dougl.
114. Castilleia foliolosa Hook. & Arn.
115. Castilleia parviflora Bong.
116. Monardella lanceolata Gray.
117. Micromeria Douglasii Benth.
118. Audibertia Palmeri Gray.
119. Audibertia polystachya Benth.
120. Verbena prostrata R. Br.
121. Plantago Patagonica Jacq.
122. Mirabilis Californica Gray.
123. Rumex salicifolius Weinmann.
124. Eriogonum nudum, var. pauciflorum Wats.
125. Eriogonum giganteum Wats.
126. Chorizanthe staticoides Benth.
127. Pterostegia drymarioides Fisch. & Meyer.
128. Atriplex Coulteri Dietrich.
129. Urtica holosericea Nutt.
130. Urtica urens Linn.
131. Parietaria debilis Forster.
132. Eremocarpus setigerus Benth.
133. Salix lævigata Bebb.
134. Populus trichocarpa T. & G.
135. Quercus Douglasii Hook. & Arn.
136. Quercus dumosa Nutt.
137. Quercus tomentella Engl.
138. Calochortus Kennedyi Porter.
139. Calochortus Catalinæ Wats.—coll. by P. Schumacher.
140. Juncus bufonius Linn.
141. Stipa setigera Presl.
142. Avena fatua Linn.
143. Melica imperfecta Trin.
144. Hordeum murinum Linn.
145. Elymus condensatus Presl.
146. Gymnogramme triangularis Kaulf.
147. Gymnogramme triangularis, var. viscosa Eaton.
148. Pellæa ornithopus Hook.
149. Adiantum emarginatum Hook.
150. Aspidium aculeatum Swartz.
151. Selaginella rupestris Spring.

LIST OF FLOWERING PLANTS AND FERNS OF SAN CLEMENTE ISLAND.

1. Eschscholtzia elegans, var. ramosa Greene.
2. Delphinium variegatum Torr. & Gray.
3. Meconopsis heterophylla Benth.
4. Sisymbrium reflexum Nutt.
5. Lepidium nitidum Nutt.
6. Oligomeris subulata Boiss.
7. Lepigonum macrothecum Fisch. & Meyer.
8. Claytonia perfoliata Donn.
9. Lavatera assurgentiflora Kellogg.

10. Malva borealis Wallman.
11. Erodium cicutarium L'Her.
12. Erodium moschatum L'Her.
13. Rhus integrifolia Benth. & Hook.
14. Rhus ovata Watson.
15. Lupinus affinis Agardh.
16. Trifolium microcephalum Pursh.
17. Trifolium Palmeri Watson.
18. Medicago denticulata Willd.
19. Hosackia ornithopus Greene.
20. Astragalus Nevinii Gray, *ined.*
21. Vicia exigua Nutt.
22. Cotyledon?
23. Mentzelia gracilenta T. & G.
24. Megarhiza Californica Torr.
25. Cereus Emoryi Engl.
26. Opuntia prolifera Engl.
27. Mesembryanthemum nodiflorum.
28. Mesembryanthemum crystallinum Linn.
29. Bowlesia lobata Ruiz. & Pavon.
30. Sanicula bipinnatifida Dougl.
31. Daucus pusillus Michx.
32. Galium Aparine Linn.
33. Gnaphalium decurrens Ives.
34. Hemizonia Streetsii Gray.
35. Perityle Fitchii Torr.
36. Baeria Palmeri Gray, var. Clementina.
37. Eriophyllum Nevinii Gray, *ined.*
38. Achillea Millefolium Linn.
39. Senecio Lyoni Gray, *ined.*
40. Microseris Lindleyi Gray, *ined.*
41. Malacothrix foliosa Gray, *ined.*
42. Sonchus oleraceus Linn.
43. Gilia Nevinii Gray, *ined.*
44. Gilia micrantha Steudel.
45. Nemophila racemosa Nutt.
46. Phacelia floribunda Greene.
47. Phacelia phyllomanica Gray.
48. Phacelia distans Benth.
49. Krynitzkia ambigua Gray.
50. Convolvulus macrostegius Greene.
51. Lycium Californicum Nutt.
52. Antirrhinum Nuttallianum Benth.
53. Antirrhinum speciosum Gray.
54. Collinsia bicolor Benth.
55. Plantago Patagonica Jacq.
56. Mirabilis Californica Gray.
57. Abronia umbellata Lam.
58. Rumex salicifolius Wein.
59. Eriogonum nudum, var. pauciflorum Wats.
60. Erigonum (n. sp.) unfit for determination.
61. Pterostegia drymarioides Fisch. & Meyer.
62. Aphanisma blitoides Nutt.
63. Chenopodium Californicum Wats.
64. Chenopodium album Linn.
65. Atriplex microcarpa Dietrich.
66. Atriplex leucophylla Dietrich.
67. Atriplex Californica Moquin.
68. Hesperocnide tenella Torr.
69. Parietaria debilis Forster.
70. Allium serratum Watson.
71. Brodiæa capitata Benth.
72. Phalaris Canariensis Linn.
73. Stipa setigera Presl.
74. Melica imperfecta Trin.
75. Ceratochloa grandiflora Hook.
76. Hordeum nodosum Linn.
77. Polypodium Californicum Kaulf.
78. Gymnogramme triangularis Kaulf.
79. Notholæna Newberryi Eaton.
80. Layia glandulosa H. & A.
81. Amsinckia intermedia Fisch. & Meyer.

ADDITIONAL NOTES.—In the very nature of things all islands, and these in a superlative degree, being largely exempted from the disturbing external influences affecting organic life upon the mainland, present to the naturalist an inviting field of exploration and research.

To the enthusiastic lover of the beautiful in nature, they offer as well a wealth of picturesque attractions. The southern coast of San Clemente once seen can never be forgotten. Against vertical cliffs of over two hundred feet the great seas dash with thunderous noise and appalling force, whilst far above, the rocky terraces, all softened with tender creamy lichens and whose darkling

caves each carry a drooping portière of lovely snow-white morning glories, forms in all a combination of rare grandeur and dainty prettiness seldom seen in one picture.

Catalina is a miniature world in itself. The landward coast is indented with little pockets rather than harbors, whose waters are marvels of tranquillity and pellucidity. From his boat the fisherman can look down and at a depth of fifty feet see the brilliant anemones and sea urchins starring the rocks below.

From the middle of the island two not inconsiderable streams (in California we call them rivers) take their source and flow in opposite directions, one through a sandy valley with here and there a fertile oasis of cottonwoods, anon a desert of prickly pear or tuñas within whose cruel environment lurks the dainty edible fruit of Solanum Xanti, var. Wallacei. The other "river" takes its way southerly through cañons of the loftiest mountains of the island until it plunges into Silver cañon; and thence to follow its precipitous course to the sea will try the nerves of the trained mountaineer. Down into the very bowels of the earth one seems to go, into ravines whose walls are vertical battlements of rock that not even a goat could scale, and into whose chilling and darkening depths the sun never looks; it is then that when a "break off" or falls occurs in the descent that the situation becomes interesting—critical, perhaps, for him who will not or can not retreat.

But Catalina is not all made up of dangerous cañons; its endless diversity constitutes its chiefest charm; teeming pastoral valleys where the track of the waterways fairly dazzle the eye with its splendor of Mimulus cardinalis, or enchanting nooks carpeted with gold fern or Aspidium aculeatum, else rolling hills or grim castellated mountains, constitute an aggregation of beauties and attractions to the traveler and explorer unequalled anywhere in Southern California.

Though I have spoken of my work upon these islands as "gleanings" the *harvest* on most of them as yet is virtually untouched, and offers a fruitful field to the zealous collector. If my remarks should stimulate any to their thorough and comprehensive exploration, my labor shall not have been in vain.

BRIEFER ARTICLES.

New grasses.—SPOROBOLUS BOLANDERI. Culms slender, about a foot high decumbent below, smooth: leaves narrowly linear, flaccid; radical ones about 6 inches long; cauline ones similar, 1 to 2 inches long; ligule short and obtuse; upper half of stem naked: panicle 2 to 3 inches long, sparsely flowered, open, lax, lower branches in twos or threes, filiform, 1 to 1½ inches long, flowering above the middle: spikelets about 2 inches long; empty glumes unequal, 1-nerved, upper one ovate-lanceolate, 1 line long or more, lower one ¼ shorter; flowering glume nearly 2 lines long, oblong-lanceolate, 5-nerved, softly pubescent on the nerves below; palet equaling its glume, finely ciliate on the nerves; sterile pedicel prominent, ⅓ to ½ as long as the flower.—Collected at Multinomah Falls, Oregon, by Dr. H. N. Bolander.

AGROSTIS ATTENUATA. Culms slender, smooth, erect, attenuated, 2 to 3 feet long: radical leaves narrowly linear, 2 to 4 inches long; culm leaves 3, distant, sheaths shorter than the internodes, smooth; ligule membranaceous, conspicuous, 2 to 3 lines long; blade 2 to 3 inches long, narrow, acuminate: panicle 3 to 4 inches long, pyramidal, lower branches in threes or fives, somewhat unequal, 1 to 2 inches long, capillary, few-flowered, pedicels mostly longer than the spikelets, which are about 1½ lines long: empty glumes equal, oblong-lanceolate, acute, scabrous on the keel; flowering glume nearly as long; palet wanting.—Found by Mr. Thomas Howell, near Mt. Hood, Oregon. It belongs to the *scabra* group, but is well distinguished as a species.

AGROSTIS FOLIOSA. Culms stoloniferous, erect, 1½ feet high, leafy nearly to the summit: leaves 3 to 5 inches long, 2 to 3 lines wide, acuminate, somewhat scabrous; sheaths smooth; ligule short, obtuse: panicle lanceolate, 4 to 6 inches long, 1½ inches wide below, open, branches mostly in fives, uneven, ½ to 1½ inches long, flowering near the extremities, subdivided mostly below the middle, pedicels longer than the spikelets, which are about 1½ lines long: empty glumes lanceolate, acute; flowering glumes a little shorter, about 5-nerved, the lateral nerves excurrent at the apex, the midnerve usually terminating in a short awn near the middle; palet wanting.—Collected in Oregon by Thomas Howell and by Dr. H. N. Bolander.

MUHLENBERGIA NEO-MEXICANA. Perennial: culms mostly branched near the base from thickened nodes, wiry, erect, 1 to 2 feet high, scabrous: cauline leaves about 5, setaceous, erect, about 3 inches long, the upper one near the panicle; ligule short, lacerate: panicle narrow, linear to lanceolate, 4 to 6 inches long, the branches unequal, mostly in twos, appressed, the longer 1 to 2 inches long, flowering to the base, the branchlets sessile and closely flowered: spikelets sessile or nearly so, about 2 lines long without the awn; empty glumes equal, more than half as long as the spikelet, lanceolate, acuminate or awl-pointed, 1-nerved; flowering glume short stalked, 3 nerved, narrow, acuminate and terminating in a straight, slender awn 4 to 6 lines long.—Rocky hills and mountain sides, New Mexico and Arizona.

MUHLENBERGIA ACUMINATA. Culms erect, 3 to 4 feet high, smooth: rad-

ical leaves involute, 6 to 12 inches long; cauline ones 3 or 4, distant, narrow, becoming involute, acuminate, lower 6 to 8 inches long, upper 1 to 2 inches, scabrous; ligule 3 to 4 lines long, lacerate: panicle linear, 6 to 10 inches long, branches in twos or threes, closely appressed, the lower 1 or 2 inches long, flowering to the base, branchlets short and erect; pedicels and rhachis scabrous: spikelets 2 lines long; empty glumes half as long, nearly equal, obtuse and denticulate at the apex, membranaceous; flowering glume 2 lines long, rigid, 3-nerved, acuminate, and terminating in a minute awn, about a line long; palet as long as its glume, acute.—Number 1993, C. Wright's collection in New Mexico. A well marked species.—Dr. GEORGE VASEY.

Ambrosia bidentata ×trifida.—A hybrid from these parents has been sent to us by Mr. Eggert, of St. Louis. That district is famous for hybrids, Dr. Engelmann having detected so many there, but this one, we believe, is new. A. GRAY.

Selinum Canadense in Indiana.—The discovery of this northern species in middle Indiana is a very interesting fact. Known to students of Gray's Manual as Conioselinum Canadense, or Hemlock-Parsley, its range is entirely north of Indiana, except as it finds its way southward along the higher summits of the Alleghanies, and is usually found in swamps. I found it a little over a mile north of Crawfordsville, clinging to an almost inaccessible bluff wall, in surroundings kept constantly cold and wet by springs. It was in both flower and fruit October 15.—J. N. ROSE.

Dr. George Martin.—Those interested in mycology will be pained to learn of the recent death of Dr. George Martin. The study of our American fungi was with the deceased a thing of recent years, and was taken up mainly because he saw in it an opening for good work in its relation to practical medicine. However it was not long before he became so interested in these plants that almost his whole leisure and strength were given to them. When one remembers how many of the specimens in Ellis' Centuries of North American Fungi were collected, and how many more were critically studied by Dr. Martin, there will be a surprise to know that he had been for years an invalid whose life hung upon the slenderest thread. The deceased left behind him a manuscript volume which might well be published as a memorial of his labors. It contains a large number of colored illustrations, with spore measurements, and descriptions of the fungi he had studied. Such a volume would be a real boon to American mycologists. During his life, when urged by his friends to publish it, his modesty always led him to evade the question or to depreciate the real value of what he had done. He was distinguished as a physician, high-toned and honorable as a man, public-spirited as a citizen, and warm-hearted as a friend. None can regret his death more than his neighbors in West Chester, Pa., who knew and loved him well.—J. T. ROTHROCK.

Two new Californian plants.—On making for the first time a botanical excursion to Monte Diablo I found upon its very summit the little *Campanula* here described which has heretofore been overlooked, probably on account of ts diminutive size and ephemeral duration, rather than from its absolute

rarity. It may have been passed over as a *Githopsis*, as it has somewhat the aspect of a depauperate form of this common plant.

The following species of *Gilia* was also found in a district supposed to be pretty thoroughly explored. Professor Gray informs me that I may regard it as a new species, quite as good as some other of the troublesome forms which have come to light, and which almost efface the distinction between the sections *Dactylophyllum* and *Leptosiphon*. I have had Professor Gray's kind and needful help in shaping the characters of these two species so as to render them more diagnostic than they would have been in my inexperienced hands.

CAMPANULA EXIGUA. Annual, 2 to 5 inches high, with spreading branches, hirsute below, puberulent or almost glabrous above: leaves very small (1 to 3 lines long), sessile, lowest lanceolate or obovate, entire or with a few coarse teeth, upper subulate: flowers solitary at end of the slender divergent branches or short peduncles, erect: calyx-lobes subulate-linear, usually twice the length of the campanulate or somewhat turbinate tube, erect, connivent after flowering: corolla oblong-campanulate, light blue; tube about the length of the calyx-lobes, longer than its oblong acute lobes; filaments abruptly dilated below the middle into a broad ciliolate base: style not surpassing the corolla: capsule somewhat urceolate, opening by three valves above the middle.—Summit of Monte Diablo, June 14, 1886. Also collected, July 3, on Tamalpais, by Mrs. Curran, in full fruit and in a larger and coarser form. The species will rank along with *C. Reverchoni* of Texas, in a separate subdivision.

GILIA AMBIGUA. Habit and foliage of *G. Bolanderi*, but more erect and stouter: corolla much larger, over half-inch long, nearly thrice the length of the calyx, its proper tube equalling the latter or somewhat exserted, the obconical brown-purple throat of nearly same length and hardly exceeded by the rotately expanding bluish purple lobes: ovules 2 in each cell.—Very abundant at Oak Hill, four miles south of San Jose, May 15, in flower and fruit. The only other *Gilia* seen near it was *G. dichotoma*.—VOLNEY RATTAN.

A pleasing experiment in laboratory practice.—The following experiment has proved very satisfactory with classes in vegetable anatomy while upon the subject of mucilaginous modification of the cell wall. The student makes a thin section of a flaxseed and places it dry under the $\frac{1}{6}$ objective so that the outer layer of the external coat is in the field. Pass a drop of water under the cover-glass and watch the section. As soon as the liquid strikes the mucilaginous layer the cells composing it at once enlarge and their dissolved contents float out upon the slide. That which before was a hyaline line, seemingly amorphous, becomes a series of cells nearly uniform in size. The thinness of the section and the unusual exposure of the mucilage permits of the quick outward movement of the cells much to the delight of the student. For a time it was quite a puzzle how the side walls of the rapidly expanding cells could accommodate themselves to the sudden expansion. A quantity of flaxseed was soaked in water, the liquid being changed frequently during a day or more, and the seeds afterwards dried with blotting paper. Upon making thin sections of these seeds, and treating the outer layer as above described, the side walls were well defined, and their method of expanding became plain. These

walls are folded or plaited right and left like the sides of the bellows of an accordeon, the plaits being widest at the bottom, or attached ends, and diminish outward toward the exposed surface. These cells are somewhat irregular, but are usually six sided. If a superficial or thin tangential section of the seed-coat is carefully experimented upon, the mucilaginous cells may be expanded and contracted several times before their contents so far disappear as to arrest further action.

If the student attempts to study the mucilaginous covering without making a section the expansion of the cells and the outward flow of their contents are so slow as to be disappointing. When the thin section has been brought into the field of the high power lens it is well for a neighboring student or an assistant to add the drop of water, thus giving the experimenter the entire use of his time for making the observation.—BYRON D. HALSTED.

Alaskan plants.—List of plants collected during the summer of 1885, at Ounalashka, by Mr. S. Applegate, the United States Signal Observer at that station. The list, although small, contains several species of great rarity and interest:

Cardamine pratensis L.
Draba hirta L.
Leptarrhena pyrolifolia R. Br.
Epilobium angustifolium L ? Fragments only.
Oxyria digyna Camp.
Luzula campestris DC.
Luzula spadicea DC., var. parviflora Led.
Juncus arcticus Willd.
Juncus Scheuchzeri Hoppe.
Carex decidua Boott. Very rare: the third station in North America. (Fide Bailey in litt. Oct. 22, 1886.)
Carex podocarpa R. Br.
Carex limosa L., var. stygia Bailey.
Festuca rubra L.
Bromus Aleutensis Trin.
Poa pratensis L.
Deschampsia atropurpurea Scheele.
Deschampsia cæspitosa P. Br., var. longiflora Trin.
Trisetum subspicatum P. Br., var. molle Gray.
Deyeuxia Aleutica Vasey.
Deyeuxia Langsdorfii Kunth.
Agrostis canina L.
Agrostis exarata Trin.
Equisetum variegatum Schl.
Cryptogramme acrosticnoides R. Br.

I am indebted to Dr. Vasey and Prof. L. H. Bailey, Jr., for assistance in determining the sedges and grasses.—F. H. KNOWLTON, *U. S. Nat. Museum.*

EDITORIAL.

WITH THIS number the GAZETTE for 1886 is complete. The 350 pages that we have given to our readers represent the best botanical activity of the country, and the fact that several important papers presented this year cannot appear until next, on account of the pressure upon our pages, goes to show that this activity has been unusually great. It is very evident that botanists are working now as never before in this country. Perhaps there is no more interest in the general subject of botany, but there is more independent and valuable work. Our friends have said that the GAZETTE has been no small influence in encouraging this activity. Whether this is true or not, the botanical signs for 1887 are most encouraging. American botanists are fully awake, and the next year gives promise of much good work. Every botanist should feel called upon to help along this progress, both by making some contribution to botanical knowledge himself, and by warmly supporting a botanical journal that

gives expression to these activities. That the GAZETTE has been better than its promise is the record of the year just closing, and as we clear our decks for another year it is with the determination to surpass anything we have yet done. With this promise to our friends we wish them a happy and successful new year.

THERE IS some feeling among American botanists that their labors are not fully recognized in Europe, being passed by when credit is really due them. We desire to point out one reason for this apparent neglect, a reason that our opportunities of knowing enable us to assert is a very important one, and which points to partial remedy within the control of each author. We refer to the distribution of separately printed copies of important articles contained in journals and society publications. We venture to say that the number of copies now sent by most authors to German and other foreign investigators is very small and wholly inadequate. A satisfactory distribution would require that a copy of every important research should be sent to other workers in the same line, to the prominent botanical periodicals, and to the chief libraries. If it can also be placed on sale, so much the better. If authors will take this small trouble and expense, the knowledge and recognition of American botany abroad will be advantageously improved.

OPEN LETTERS.

Orientation of Cassia leaflets.

The region about me is literally clothed with a growth of the two species of Cassia, C. nictitans and C. Chamæcrista. I notice this summer what I never happened to have observed before, that, in the afternoon especially, all the leaflets are so disposed as to present their surfaces to the declining sun. In thousands of specimens I can find no exception. This presentation of necessity gives something of a north and south trend to the edge of the leaflets, so here we have compass plants of a certain kind. W. W. BAILEY.

Brown University, Providence, R. I.

Eupatorium perfoliatum.

In August last I collected a stout specimen of this plant, nearly four feet high, having a whorl of three leaves at each node. The leaves of each whorl were united around the stem much as in the usual form, except that there was a superfluity of tissue at the points of cohesion, thus making the bases of the leaves crispate. J. FRANKLIN COLLINS.

Providence, R. I.

CURRENT LITERATURE.

Life Histories of Plants. By Professor D. McAlpine. pp. 296. Illustrated. Swan Sonnenschein, Lowrey & Co., London. 1886. sq. 12°.

This is a successful attempt to put the latest phases of botany in such a popular way that any intelligent person can understand them. Such attempts can not be too warmly commended, for they are important and difficult. As the intelligent popular mind becomes acquainted with these facts the chances for foundations for original investigation multiply, but the difficulty lies in

popularizing without misstating. Professor McAlpine has accomplished this task as well as we have yet seen it done. The book was not written for botanists, but it should be able to stand the fire of their criticism. At the same time botanists must not criticize technical points or omitted facts. It is simply a question as to whether what has been stated is clear enough to be understood or is not misleading. The book begins with a chapter upon the comparative study of plants and animals on a physiological basis, and another upon the living cell. The remaining pages take up types, beginning with the lowest, and give a condensed account of their structure and life history, over forty being considered. The book is not only a capital one for the general reader, but would be very helpful in the hands of the young laboratory worker. The figures are the same that have done such long and efficient service in botanical works, and a few changes in that direction would have been both easy and valuable. There are some things that might be criticised. In referring to the function of chlorophyll, p. 69, Pringsheim's "screen" theory is given without any mention of there being a diversity of opinion upon the subject. The use of the terms "root" and "shoot" are carried down to the lowest plants on physiological grounds, but the average reader will not distinguish between root-function and root-structure, and so we would class the use of these terms as misleading. The terms "microspore" and "macrospore" are carried through to the highest plants, a thing proper enough perhaps for the technical botanist, but the audience for whom the book is written had better know what the pollen-grain and embryo-sac mean. On p. 229, in speaking of the germination of the teleutospores of wheat-rust, the statement that they "*only* continue their course of development on the Barberry-leaf," should be modified in accordance with the fact. But these are mostly matters of judgment, and we would commend the book as being very readable and serviceable.

Preliminary Synopsis of North American Carices, including those of Mexico, Central America and Greenland, with the American bibliography of the genus. By L. H. Bailey, jr. pp. 99, v. Reprinted from Proc. Amer. Acad., April 14, 1886.

That the genus Carex needs elucidation all botanists will agree, and Professor Bailey has done us good service in thus recording the results of his study. A proper judgment upon such work can be passed only after using it, and whatever is said now is based upon the author's known ability. Such a vast genus is, of necessity, a most bewildering tangle, and if Professor Bailey has straightened it all out he has done far more than he claims. Of course it will be found faulty in parts, and the author will probably be quicker to recognize that than any one else, but it must surely advance our knowledge of carices and lighten the labor of naming them. Changes in nomenclature are quite numerous and radical, and the author deserves commendation for his attempt to observe the law of priority. The paper gives distinguishing characters for all species not described in Gray's Manual, Chapman's Flora and Coulter's Manual. The breaking away from the old artificial groupings, and the attempt to distribute species in natural groups, is noteworthy. Professor Bailey has put us under an obligation which should be repaid by the careful use and criticism of his paper.

NOTES AND NEWS.

THE HERBARIUM of Lamarck has been acquired by the French government and placed in the Jardin des Plantes.

PROF. W. W. BAILEY finds that the stamens of Parnassia mature one at a time, and asks if this has been observed before.

THÉODOR G. ORPHANIDÈS, emeritus professor of botany at the university of Athens, died in August last at 69 years of age.

DR. EMILY L. GREGORY presents the first part of a paper on the distribution and function of the pores of libriform tissue, in the *Bulletin of the Torrey Club* for November.

PROF. O. NORDSTEDT has critical notes on the marine Vaucheria litorea, V. sphærospora, V. Thuretii and V. Synandra, illustrated with a plate, in the October *Scottish Naturalist*.

A WELL WRITTEN and readable notice of Lubbock's "Flowers, Fruits and Leaves," covering over a page, is given in No. 1115 of the *Nation*, under the title of "Vegetal æsthetics."

A. A. CROZIER, graduate of Michigan Agricultural College and of the botanical department of the State University, has been appointed assistant to Dr. Vasey in the Department of Agriculture.

SPIRANTHES ROMANZOVIANA has been a very rare orchid in Ireland for fifty years or more, and is now thought to be entirely exterminated. A systematic search for it is talked of for next year.

PROF. DR. LEIMBACH, editor of *Irmischia* and of the *Deutsche botanische Monatsschrift*, has removed from Sondershausen to Arnstadt, where he has accepted the position of director of the Realschul

BARON F. VON MUELLER will next June resign his position as director of the Botanical Garden of Melbourne, Australia.

MISS LILLIE J. MARTIN'S paper on the preliminary analysis of the leaves of Juglans nigra, read before the A. A. A. S., Buffalo meeting, has been issued as a reprint from the *Amer. Jour. of Phar.*, October, 1886.

DR. THEOBALD SMITH expresses some thoughts on recent investigations concerning bacteria in drinking water, in the *Medical News* of October 9, which are especially valuable to those engaged in such researches.

DR. J. W. A. WIGAND, the renowned professor of botany at the University of Marburg, is dead, at the age of sixty-five years.

FOUR FRENCH BOTANISTS have recently died: L. D. A. F. M. Marcilly, conservator of forests; Guillaume Sicard, mycologist; Ed. Lamy de la Chapelle, lichenologist: and Jean Baptiste Pierre Letendre, cryptogamist.

ON PAGE 260, October *Gazette*, is an omission which should be corrected. To the characters of § 1 should be added "ducts peripheral."

DESCRIPTIVE NOTES on Papuan plants, by Baron F. v. Mueller, cover 120 octavo pages, and include many new species. The descriptions are in English.

ERRATA.—Page 263, for Epeclus, Pelopocus, Stizua and Trichina, read *Epeolus*, *Pelopœus*, *Stizus* and *Trichius*. In foot-note 5 for "bears a resemblance" read bears *no* resemblance.

MR. JOHN H. REDFIELD continues his notes in the November *Bulletin of the Torrey Club*, upon localities for Corema, with an account of explorations for 1886.

THE SOCIEDADE BROTERIANA, of Coimbra, publishes an annual bulletin, issued in parts, which has now reached its fourth volume. It is devoted to the study of the flora of Portugal, and has already brought to light quite a number of new species.

BARON VON MUELLER'S activity in making known the flora of Australia and adjacent regions is shown in his almost monthly publication of new species of flowering plants in the *Victorian Naturalist*, *Australasian Journal of Pharmacy*, and other journals.

THE MYXOMYCETES are noticed in the August and November numbers of the *Journal of Mycology* by critical notes on the banded-spore Trichias by Dr. George A. Rex, and by the description of a new genus and species, Orthotrichia microcephala, by Harold Wingate.

PROF. A. N. PRENTISS has written in the *Am. Horticulturist* (reprinted in the *Am. Naturalist* for November) upon how botany shall be taught in agricultural colleges. What he suggests finds its application not only in agricultural colleges, but wherever botany is taught.

TWO NEW WORKS of much interest are announced from the press of Swan Sonnenschein, Lowrey & Co., London. The first is a "Text book of practical botany," edited from the work of Strasburger by Prof. W. Hillhouse, and the other is "The microscope, in theory

and practice," edited from the work of Nägeli and Schwendener by J. Mayall. A new edition, entirely re-written, of Prantl and Vines' "Text book of botany," is also announced by the same firm.

MICROSPORES in Sphagnum were described by Schimper in 1858. They were found in separate capsules, and also intermixed with the macrospores. They do not appear to have been seen again, however, until a few months ago. The subject is discussed by C. Warnstorf in *Hedwigia*.

THE COMPLETE life history of Gnomonia erythrostoma has been traced by Dr. Frank (*Berichte d. deutsch. bot. Gesellschaft*, iv, p. 200), making the second Pyrenomycetous fungus in which the sexual reproduction is known. It attacks the leaves of the cherry tree, enfeebling the tree, and finally killing it.

A LIST of the Diatomaceæ of Lake Michigan, by B. W. Thomas and H. H. Chase, is the result of collections from the Chicago water supply, made chiefly by Mr. Thomas during the last sixteen years. Two hundred and fifteen species and varieties are enumerated, six of which are marked *n. sp.*, and one *n. var.*

MR. J. H. HART, superintendent of the government cinchona plantations, Jamaica, has issued from the press of Mortimer C. DeSouza, Kingston, a very interesting account of "A Botanist's Rambles" in Central America. It gives a sketchy account of the plants of that interesting region and is well worth reading. It can be had from the author for a sixpence.

MR. D. H. CAMPBELL is at present at Bonn, studying in Strasburger's laboratory. He reports but two or three working there during the winter semester, but that during the summer the number will reach 30 or 40. Dr. Strasburger takes great personal interest in the work of his students, and gives them more attention than would be expected from so busy a man.

DR. C. C. PARRY, in a reprint from the Proc. Davenport Acad. Sci., v. 35, confirms the genus *Lastarriæa* Remy and extends its character. In his memoir on Chorizanthe he had included this genus as C. Lastarriæa, but two new species from Chili have confirmed its generic characters, and so it has been restored and becomes *L. Chilensis* Remy, with two Chilian associates.

M. C. COOKE criticizes Stevenson's recent work on "British fungi," in a late issue of *Nature*, by charging that over forty species were wrongly omitted from the first volume, and for other faults, none of which, however, materially affect the value of the work for American botanists. It must be remembered that Dr. Cooke's views rarely coincide with those of his fellow mycologists.

AT THE LAST annual meeting of the Union of Naturalists' Societies of the East of Scotland, Prof. J. W. H. Trail gave an address on the work to be done by such an organization, which in the main is equally pertinent to American societies. He placed bibliographical indexes first, and local lists of different classes of natural history second, both to be prepared by the coöperative system.

"THE WIND as a seed-carrier," was the title of a paper presented by Alfred Russell Wallace at the November meeting of the National Academy of Sciences, in which the author suggested that the power of the wind to occasionally carry seed to extraordinary distances might account even for the transfer of species from cold regions of the northern hemisphere to those of the southern.

BULLETIN No. 1 of the botanical division of the U. S. Department of Agriculture, by Dr. George Vasey, is devoted to economic questions regarding the grasses of the arid districts of Kansas, Nebraska and Colorado, including an item on the advantages of establishing a grass-experiment station. We are otherwise informed that a bill for this purpose will be presented at the next session of Congress.

HERR F. FREYN, engineer, (whose address is III, Karmelitergasse, 21, Prague), who has paid much attention to the genus *Ranunculus*, and is preparing a general work on the species, wishes to obtain specimens of those of North America generally, especially of the newly found and the rare or critical species. Indeed, good specimens of any of our species will be welcome. European species are offered in return.

A BIOGRAPHICAL SKETCH of the botanist Mühlenberg, with portrait, has been distributed as a reprint from Hoffman's "Pharmaceutische Rundschau," June, 1886. It is written by Dr. J. M. Maisch, of the Philadelphia College of Pharmacy, and is exceedingly interesting. As closely identified with early American botany as Mühlenberg was, it is specially fitting for American botanists to be acquainted with his life.

THE OCTOBER NUMBER of the *Italian Journal of Botany* contains bryological notes by G. Venturi, the extra-floral nectary of Amygdalaceæ by L. Macchiati, description of some new Malesian Scitamineæ by B. Scortechini, notes on the fruit and seeds of Cacao by T. Caruel, a case of prolification in Spilanthes by F. Tassi, a new station for Aceras anthropophora by P. Severino, and teratological notes by C. Massalonge.

THE FOLLOWING NOTE by Dr. Asa Gray is taken from the *Gardeners' Chronicle* of November 6: "It is a mistake to say that Lespedeza striata is indigenous to most parts of North America. It is a Chinese and Japanese plant, which came to the United States nobody knows how, but not many years ago, but has now spread wonderfully in the southern United States." Notes on its history are given in this journal, vol. III, pp. 4, 42.

IN THE *Bulletin of the Torr. Bot. Club*, for November, there are three papers of systematic interest. Dr. Britton publishes a preliminary list of the N. Am. species of Cyperus, a genus which he has long been studying. Seventy-three species are enumerated, and several new varieties and species are described. Rev. E. L. Greene describes six new Californian Polypetalæ, and Dr. Vasey publishes (with plate) a new genus of grasses, dedicated to Mr. C. R. Orcutt. Orcuttia Californica belongs to the Festuceæ and was found in Lower California.

THE EDITOR of the *Botanisches Centralblatt* desires to have it announced that the report of any American botanical society will be gladly published in that journal, without translation, and fifty excerpts furnished the society free. Two hundred and fifty more copies will be supplied, if desired, at the rate of about thirty cents per page. This generous offer, which gives the society a separate printed report at little or no cost, and brings its proceedings to the notice of botanists throughout the world, ought not to remain unheeded. Address Dr. Uhlworm, Cassel, Germany.

ACTA HORTI PETROPOLITANI, vol. IX, No. 2, appears with ten folded plates and several articles of importance to systematists. C. Winkler describes twenty new Compositæ from Turkestan, E. R. Trautwetter publishes a list of a Turcoman collection, with descriptions of new species, among which the Astragali predominate. Dr. E. Regel also continues his descriptions of new or little known plants. The most important parts of Dr. Regel's contribution are the monographs of the Asiatic genus Eremostachys, and a conspectus of the species of Phlomis.

A PAPER on rhizocarps in the Erian (Devonian) period in America, by Sir Wm. Dawson, forms No. IX of the *Bulletin* of the Chicago Academy of Sciences. It treats of microscopic objects first found by Mr. B. W. Thomas and others in 1865-7, in the clays that underlie Chicago. Similar bodies have since been found in considerable quantities in Ohio, New York, Canada, Scotland, Tasmania, Australia and Brazil, and quite a literature has come into existence. They were figured and described in a bulletin of the same series in 1884, under Dr. Dawson's name of sporangites. The author now believes them to be the spores of Salvinia-like plants, and divides them into five species, under the genus Protosalvinia. The subject is of general interest in suggesting the remarkable abundance of floating rhizocarps in the period preceding the carboniferous.

DR. WILLIAM TRELEASE has published a revision of the North American species of phalictrum, distributed as a reprint of the Boston Soc. Nat. Hist., xxiii, 293-304, accompanied by a plate. The species have always been difficult of discrimination and botanists will value this accordingly. The most valuable characters are taken from the condition of the flowers (whether perfect, etc.), the length and form of filaments, the anthers, and the character of achenia. The foliage is of little diagnostic value. A dozen species are defined, one, T. venulosum, being a new species from the Rocky Mountain region, while Mühlenberg's *T. polygamum* replaces *T. Cornuti* of Gray's Manual, as already noted by the author in this journal, xi. 92. The good plate of achenia helps to make the work of determining species easy.

REV. E. L. GREENE has issued his fifth paper entitled "Studies in the botany of California and parts adjacent," being a reprint from Bulletin 6 of the Calif. Acad. Sci. Most of the contribution is taken up with a study of the genus Brodiæa Mr. Greene has observed the species in the field, and has thus discovered characters unobservable by closet botanists. The genera "confused under Brodiæa" are characterized as *Brodiæa* Smith, in part, *Hookera* Salisb., in part, and *Triteleia* Dougl., etc. A new genus, *Behria*, is added to the group, of which only the umbels are known. Comparing with Mr. Watson's revision of Liliaceæ, Brodiæa is reduced to the second half of the Eubrodiæa, Hookera contains the other half, while Triteleia includes the other two sections. Several new species are added to each genus. Mr. Greene also restores *Syrmatium* Vogel, to include 15 or 18 species of Hosackia. It was the Nuttallian genus Drepanolobus. Some 18 or 20 miscellaneous species are described as new.

MR. THOMAS MEEHAN has distributed a reprint from *Proc. Philadelphia Acad.*, containing a paper on the fertilization of Cassia Marilandica. Mr. Meehan has always been "upon the other side" in cross-fertilization discussions, disputing in general both the fact and the reason. In this paper he is more convinced than ever of his views that cross-fertilization, if accomplished, is of no benefit, and that there is little to prove that close-breeding is an injury. "In my mind, the facts rather show that instead of any material aid to the propagation of the race being gained, the dependence of a plant on insect aid for fertilization is rather an indication that its race is nearly run, and that it is on the downward track in the order of nature." He cites the Cassia as a case in point, yet says that in an experiment it did not produce a single seed when the flowers are protected from insects. The papilionaceous flowers are said to give us persistent examples of self-fertilization and hence the constancy of garden varieties.

GENERAL INDEX.

*** *Names of new species are printed in* **bold-face** *type; synonyms are printed in italics.*

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